TECHNISCHE UNIVERSITÄT BERLIN

Fakultät V – Verkehrs- und Maschinensysteme - Institut für Mechanik

FG Systemdynamik
und Reibungsphysik

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Lehrveranstaltungsankündigung SoSe 2021

6 LP nach ECTS (4 PR)

Project "Rebound Indentation Test"

Donnerstag: 08 - 10 Uhr **Beginn:** voraussichtlich Donnerstag, 15.04.2021

Für die Teilnahme an diesem Online-Kurs müssen Sie sich auf der zugehörigen ISIS-Seite einschreiben.

Anrechenbarkeit: Diplom: PI, VW, Maschinenbau, Werkstoffwissenschaften u.a.
Bachelor und Master PI: Projekt im Rahmen eines individuellen Studienverlaufplans
Alle Studiengänge: Wahlfach

Content

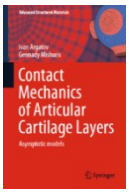
Indentation tests [1] are widely used for obtaining mechanical properties of small specimens of soft materials [2] and thin polymeric films [3]. Moreover, these tests have also been used for decades to identify mechanical properties of biological tissues and to assess their viability. Recently, it was experimentally shown [4] that the rebound deformation of an articular cartilage layer recorded after the indenter removal increases the efficiency of indentation testing.

The so-called rebound indentation test is a hybrid-type test consisting of two stages, one of which is displacement-controlled, while the other can be regarded as load-controlled. In the second stage, the rebound deformation of an articular cartilage layer is recorded after the indenter removal. A general closed-form solution for the rebound indentation test was recently obtained in [5] for a cylindrical flat-ended punch indenting a linear viscoelastic layer lying on a rigid substrate.

Based on the recently developed asymptotic models for deformation of thin viscoelastic layers, it is suggested to formulate the rebound indentation model for an arbitrary flat-ended indenter and a thin transversely isotropic viscoelastic layer (both in the compressible and incompressible cases).

In the project, you will learn the theoretical foundations of the viscoelastic contact and the practical operation of the mathematical modelling and apply them to such an application-oriented problem.

[1] Fischer-Cripps, A.C., 2002. *Nanoindentation*. Springer, New York.
[2] Dimitriadis, E.K., Horkay, F., Maresca, J., Kachar, B., Chadwick, R.S., 2002. Determination of elastic moduli of thin layers of soft material using the atomic force microscope. *Biophys. J.* **82**, 2798–2810.
[3] Zhang, C.Y., Zhang, Y.W., Zeng, K.Y., 2004. Extracting the mechanical properties of a viscoelastic polymeric film on a hard elastic substrate. *J. Mater. Res*. **14**, 3053–3061.
[4] Brown, C.P., Crawford, R.W., Oloyede, A., 2009. An alternative mechanical parameter for assessing the viability of articular cartilage. *Proc. Inst. Mech. Eng., Part H* **223**, 53–62.
[5] Argatov, I., Mishuris, G., 2011. An analytical solution for a linear viscoelastic layer loaded with a cylindrical punch: Evaluation of the rebound indentation test with application for assessing viability of articular cartilage. *Mech. Res. Comm*. **38**, 565–568.



Begleitend zum Projekt gibt es zwei aktuelle Bücher des Dozenten (Englisch):

- Argatov I, Mishuris G. **Indentation Testing of Biological Materials.** Springer, Cham, Switzerland (2015).
- Argatov I, Mishuris G. **Contact Mechanics of Articular Cartilage Layers: Asymptotic Models.** Springer, Cham, Switzerland (2015).